

HAWAII ADMINISTRATIVE RULES

TITLE 12

DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS

SUBTITLE 8

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH

PART 3

CONSTRUCTION STANDARDS

CHAPTER 156

ROLLOVER PROTECTIVE STRUCTURES; OVERHEAD PROTECTION

§12-156-1 Incorporation of federal standard

Historical note: Chapter 12-156 is based substantially upon chapter 12-129. [Eff 7/12/82; am 9/27/84; R 9/21/96]

§12-156-1 Incorporation of federal standard. Title 29, Code of Federal Regulations, Subpart W, entitled "Rollover Protective Structures; Overhead Protection", published by the Office of the Federal Register, National Archives and Records Administration, on December 30, 1971; and the amendments published on March 7, 1996, are made a part of this chapter. [Eff 9/21/96] (Auth: HRS §396-4) (Imp: HRS §396-4)

§1926.1000 Rollover protective structures (ROPS) for material handling equipment.

(a) Coverage.

- (1) This section applies to the following types of material handling equipment: To all rubber-tired, self-propelled scrapers, rubber-tired front-end loaders, rubber-tired dozers, wheel-type agricultural and industrial tractors, crawler tractors, crawler-type loaders, and motor graders, with or without attachments, that are used in construction work. This requirement does not apply to sideboom pipelaying tractors.
- (2) The promulgation of specific standards for rollover protective structures for compactors and rubber-tired skid-steer equipment is reserved pending consideration of standards currently being developed.

(b) Equipment manufactured on or after September 1, 1972. Material handling machinery described in paragraph (a) of this section and manufactured on or after September 1, 1972, shall be equipped with rollover protective structures that meet the minimum performance standards prescribed in §§1926.1001 and 1926.1002, as applicable.

(c) Equipment manufactured before September 1, 1972.

- (1) All material handling equipment described in paragraph (a) of this section and manufactured or placed in service (owned or operated by the employer) prior to September 1, 1972, shall be fitted with rollover protective structures no later than the dates listed below:
 - (i) Machines manufactured on or after January 1, 1972, shall be fitted no later than April 1, 1973.
 - (ii) Machines manufactured between July 1, 1971, and December 31, 1971, shall be fitted no later than July 1, 1973.
 - (iii) Machines manufactured between July 1, 1970, and June 30, 1971, shall be fitted no later than January 1, 1974.
 - (iv) Machines manufactured between July 1, 1969, and June 30, 1970, shall be fitted no later than July 1, 1974.
 - (v) Machines manufactured before July 1, 1969: Reserved pending further study, development, and review.
- (2) Rollover protective structures and supporting attachment shall meet the minimum performance criteria detailed in §§1926.1001 and 1926.1002, as applicable or shall be designed, fabricated,

- and installed in a manner which will support, based on the ultimate strength of the metal, at least two times the weight of the prime mover applied at the point of impact.
- (i) The design objective shall be to minimize the likelihood of a complete overturn and thereby minimize the possibility of the operator being crushed as a result of a rollover or upset.
 - (ii) The design shall provide a vertical clearance of at least 52 inches from the work deck to the ROPS at the point of ingress or egress.
- (d) Remounting. ROPS removed for any reason, shall be remounted with equal quality, or better, bolts or welding as required for the original mounting.
- (e) Labeling. Each ROPS shall have the following information permanently affixed to the structure:
- (1) Manufacturer or fabricator's name and address;
 - (2) ROPS model number, if any;
 - (3) Machine make, model, or series number that the structure is designed to fit.
- (f) Machines meeting certain existing governmental requirements. Any machine in use, equipped with rollover protective structures, shall be deemed in compliance with this section if it meets the rollover protective structure requirements of the State of California, the U.S. Army Corps of Engineers, or the Bureau of Reclamation of the U.S. Department of the Interior in effect on April 5, 1972. The requirements in effect are:
- (1) State of California: Construction Safety Orders, issued by the Department of Industrial Relations pursuant to Division 5, Labor Code, §6312, State of California.
 - (2) U.S. Army Corps of Engineers: General Safety Requirements, EM-385-1-1 (March 1967).
 - (3) Bureau of Reclamation, U.S. Department of the Interior: Safety and Health Regulations for Construction. Part II (September 1971).

§1926.1001 Minimum performance criteria for rollover protective structures for designated scrapers, loaders, dozers, graders, and crawler tractors.

- (a) General. This section prescribes minimum performance criteria for rollover protective structures (ROPS) for rubber-tired self-propelled scrapers; rubber-tired front-end loaders and rubber-tired dozers; crawler tractors, and crawler-type loaders, and motor graders. The vehicle and ROPS as a system shall have the structural characteristics prescribed in paragraph (f) of this section for each type of machine described in this paragraph.
- (b) The static laboratory test prescribed herein will determine the adequacy of the structures used to protect the operator under the following conditions:
- (1) For rubber-tired self-propelled scrapers, rubber-tired front-end loaders, and rubber-tired dozers: Operating between 0 and 10 miles per hour over hard clay where rollover would be limited to a maximum roll angle of 360° down a slope of 30° maximum.
 - (2) For motor graders: Operating between 0 and 10 miles per hour over hard clay where rollover would be limited to 360° down a slope of 30° maximum.
 - (3) For crawler tractors and crawler-type loaders: Operating between 0 and 10 miles per hour over hard clay where rollover would be limited to a maximum roll angle of 360° down a slope of 45°
- (c) Facilities and apparatus.
- (1) The following material is necessary:
 - (i) Material, equipment, and tiedown means adequate to insure that the ROPS and its vehicle frame absorb the applied energy.
 - (ii) Equipment necessary to measure and apply loads to the ROPS. Adequate means to measure deflections and lengths should also be provided.
 - (iii) Recommended, but not mandatory, types of test setups are illustrated in Figure W-1 for all types of equipment to which this section applies; and in Figure W-2 for rubber-tired self-propelled scrapers; Figure W-3 for rubber-tired front-end loaders, rubber-tired dozers, and motor graders; and Figure W-4 for crawler tractors and crawler-type loaders.
 - (2) Table W-1 contains a listing of the required apparatus for all types of equipment described in paragraph (a) of this section.

TABLE W-1

Means to measure	Accuracy
Deflection of ROPS, inches	±5% of deflection measured.
Vehicle weight, pounds	±5% of the weight measured.
Force applied to frame, pounds.	±5% of force measured.
Dimensions of critical zone, inches	±0.5 in.

- (d) Vehicle condition. The ROPS to be tested must be attached to the vehicle structure in the same manner as it will be attached during vehicle use. A totally assembled vehicle is not required. However, the vehicle structure and frame that support the ROPS must represent the actual vehicle installation. All normally detachable windows, panels, or nonstructural fittings shall be removed so that they do not contribute to the strength of the ROPS.
- (e) Test procedure. The test procedure shall include the following, in the sequence indicated:
- (1) Energy absorbing capabilities of ROPS shall be verified when loaded laterally by incrementally applying a distributed load to the longitudinal outside top member of the ROPS, as shown in Figure W-1, W-2, or W-3, as applicable. The distributed load must be applied so as to result in approximately uniform deflection of the ROPS. The load increments should correspond with approximately 0.5 in. ROPS deflection increment in the direction of the load application, measured at the ROPS top edge. Should the operator's seat be off center, the load shall be applied on the off center side. For each applied load increment, the total load (lb.) versus corresponding deflection (in.) shall be plotted, and the area under the load-deflection curve shall be calculated. This area is equal to the energy (in.-lb.) absorbed by the ROPS. For a typical load-deflection curve and calculation method, see Figure W-5.

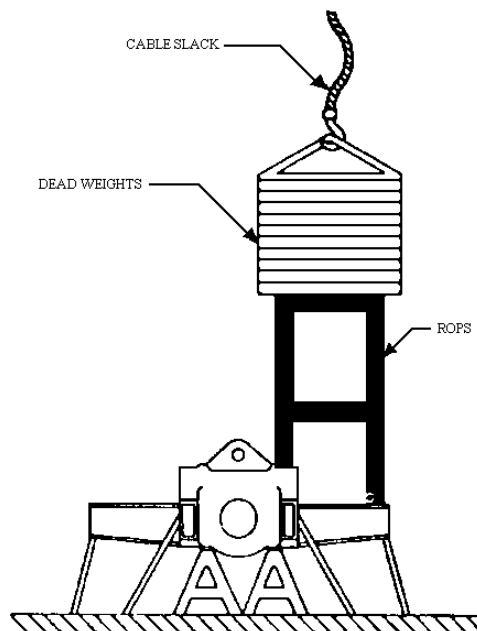


FIGURE W-1 - Vertical loading setup for all types of equipment described in §1518.1001(a).

FIGURE W-1 - Vertical loading setup for all types of equipment described in §1518.1001(a)

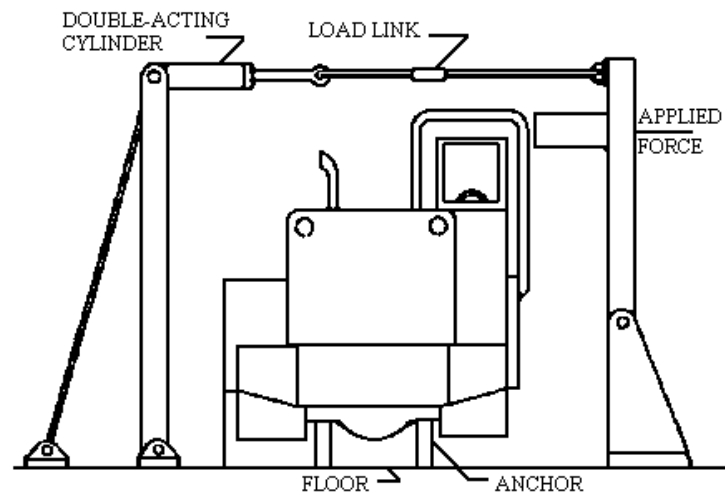


FIGURE W-2 - Test setup for rubber-tired self-propelled scrapers.

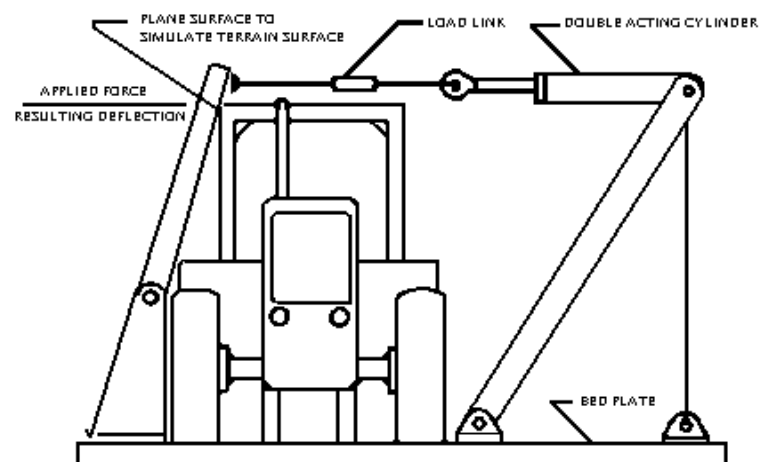


FIGURE W-3 -- Test setup for rubber-tired front-end loaders, rubber-tired dozers, and motor graders.

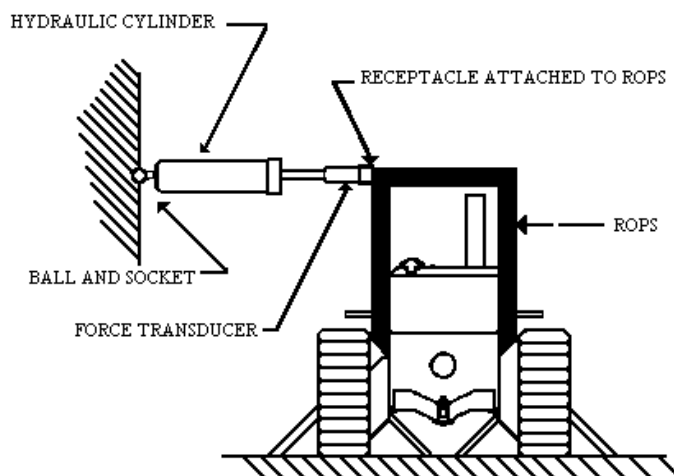


FIGURE W-4 -- Side-loading setup for crawler tractors and crawler loaders.

Incremental loading shall be continued until the ROPS has absorbed the amount of energy and the minimum applied load specified under paragraph (f) of this section has been reached or surpassed.

- (2) To cover the possibility of the vehicle coming to rest on its top, the support capability shall be verified by applying a distributed vertical load to the top of the ROPS so as to result in approximately uniform deflection (see Figure W-1). The load magnitude is specified in paragraph (f)(2)(iii) of this section.
- (3) The low temperature impact strength of the material used in the ROPS shall be verified by suitable material tests or material certification (see paragraph (f)(2)(iv) of this section).

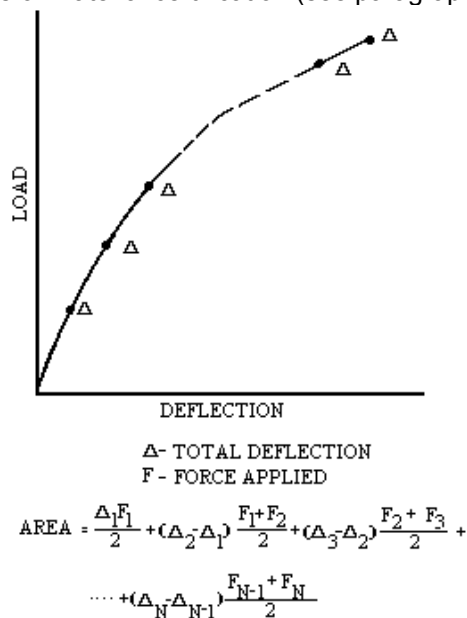


Figure W-5 - Determination of energy area under force deflection curve for all types of ROPS equipment defined in 1926.1101.

(f) Performance requirements

(1) General performance requirements.

- (i) No repairs or straightening of any member shall be carried out between each prescribed test.
- (ii) During each test, no part of the ROPS shall enter the critical zone as detailed in SAE J397 (1969). Deformation of the ROPS shall not allow the plane of the ground to enter

this zone.

(2) Specific performance requirements.

- (i) The energy requirement for purposes of meeting the requirements of paragraph (e)(1) of this section is to be determined by referring to the plot of the energy versus weight of vehicle (see Figure W-6 for rubber-tired self-propelled scrapers; Figure W-7 for rubber-tired front-end loaders and rubber-tired dozers; Figure W-8 for crawler tractors and crawler-type loaders; and Figure W-9 for motor graders). For purposes of this section, force and weight are measured as pounds (lb.); energy (U) is measured as inch-pounds.

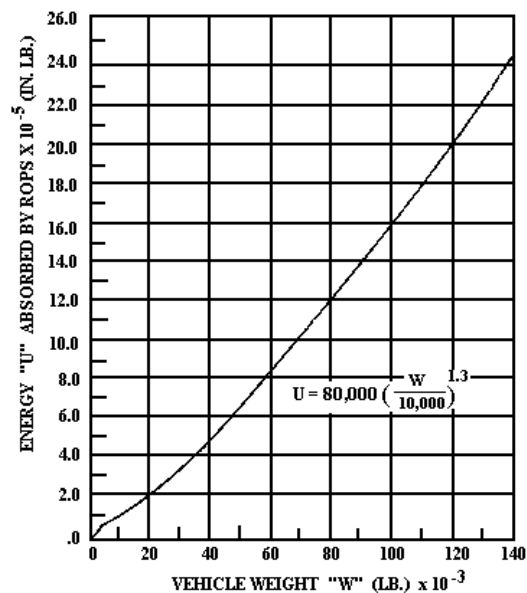


FIGURE W-6 -Energy absorbed versus vehicle Weight.

- (ii) The applied load must attain at least a value that is determined by multiplying the vehicle weight by the corresponding factor shown in Figure W-10 for rubber-tired self-propelled scrapers; in Figure W-11 for rubber-tired front-end loaders and rubber-tired dozers; in Figure W-12 for crawler tractors and crawler-type loaders; and in Figure W-13 for motor graders.
- (iii) The load magnitude for purposes of compliance with paragraph (e)(2) of this section is equal to the vehicle weight. The test of load magnitude shall only be made after the requirements of paragraph (f)(2)(i) of this section are met.

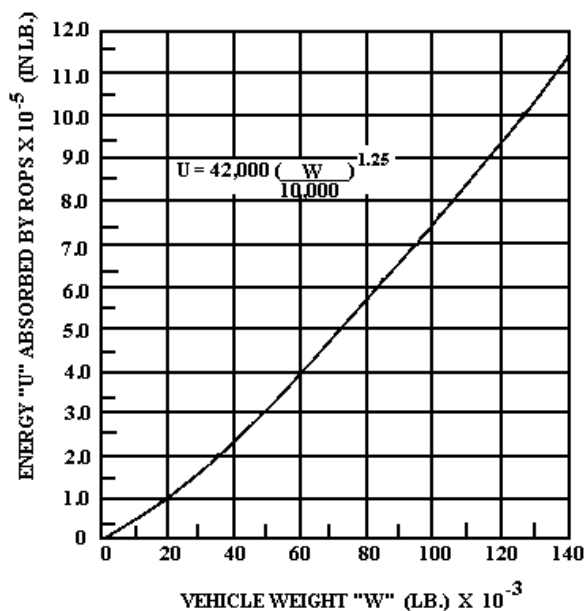
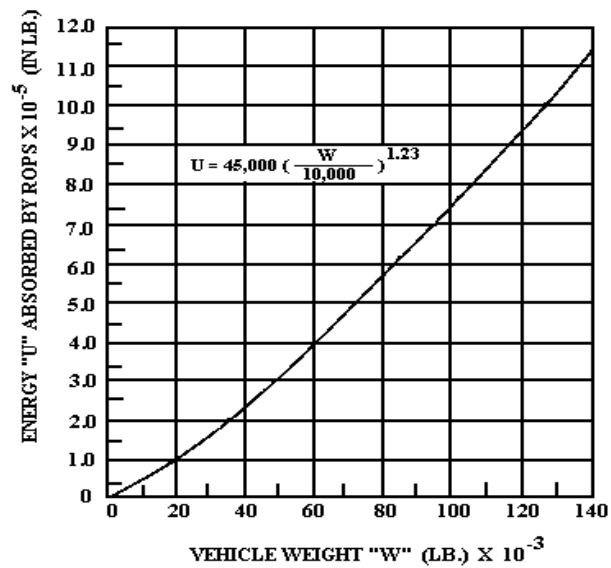
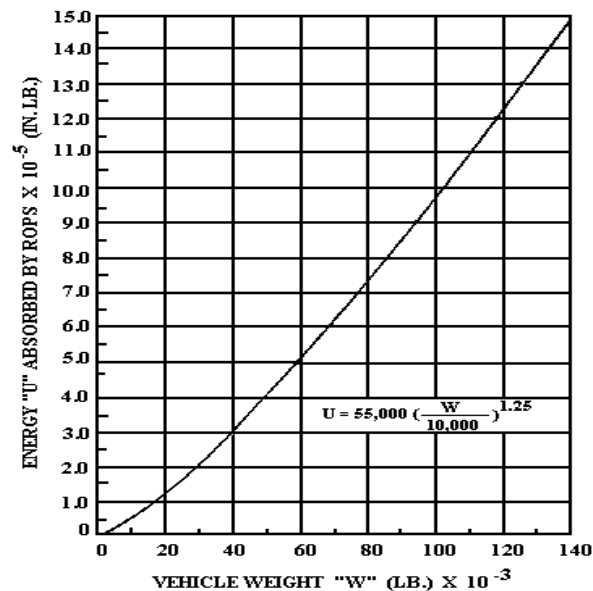


FIGURE W-7 - ENERGY ABSORBED VERSUS VEHICLE WEIGHT

- (iv) Material used in the ROPS must have the capability of performing at zero degrees Fahrenheit, or exhibit Charpy V notch impact strength of 8 foot-pounds at minus 20° Fahrenheit.

This is a standard Charpy specimen as described in American Society of Testing and Materials A 370, Methods and Definitions for Mechanical Testing of Steel Products (available at each Regional Office of the Occupational Safety and Health Administration). The purpose of this requirement is to reduce the tendency of brittle fracture associated with dynamic loading, low temperature operation, and stress raisers which cannot be entirely avoided on welded structures.

FIGURE W-8 - ENERGY ABSORBED VERSUS
VEHICLE WEIGHTFIGURE W-9 - ENERGY ABSORBED VERSUS
VEHICLE WEIGHT

- (g) Definitions. For purposes of this section, "vehicle weight" means the manufacturer's maximum weight of the prime mover for rubber-tired self-propelled scrapers. For other types of equipment to which this section applies, "vehicle weight" means the manufacturer's maximum recommended weight of the vehicle plus the heaviest attachment.

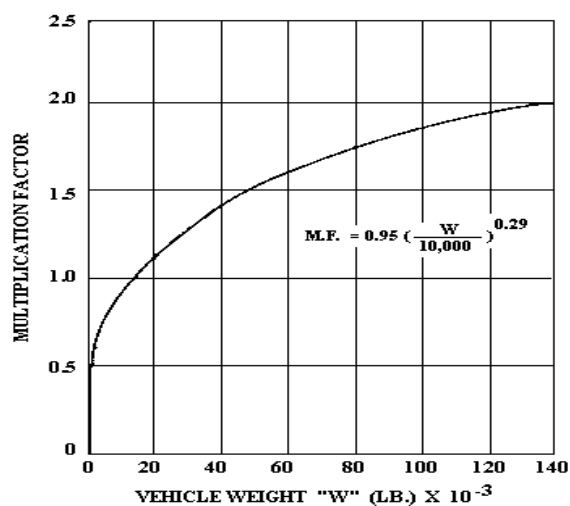


FIGURE W-10 - MINIMUM HORIZONTAL LOAD FACTOR
FOR SELF-PROPELLED SCRAPERS.

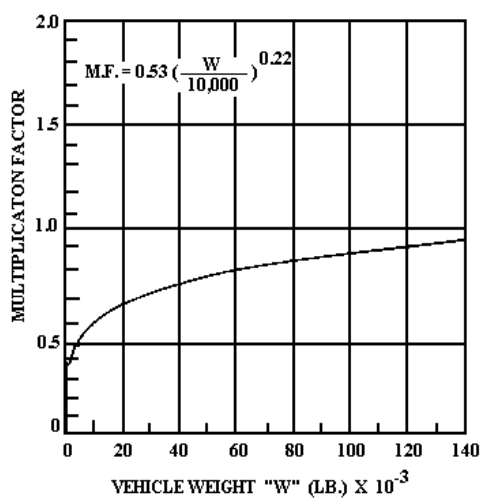


FIGURE W-11 - MINIMUM HORIZONTAL LOAD FACTOR
FOR RUBBER-TIRES LOADERS AND DOZERS.

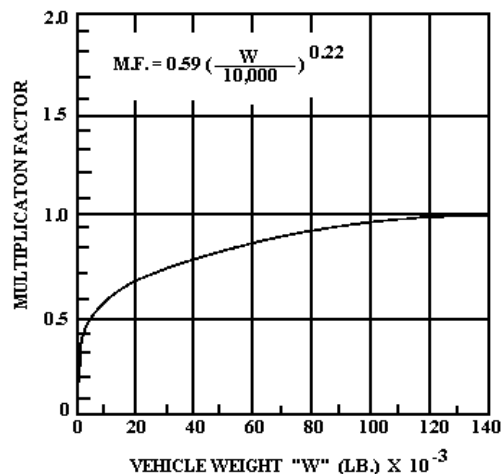


FIGURE W-12 - MINIMAL HORIZONTAL LOAD FACTOR FOR CRAWLER TRACTORS AND CRAWLER TYPE LOADERS.

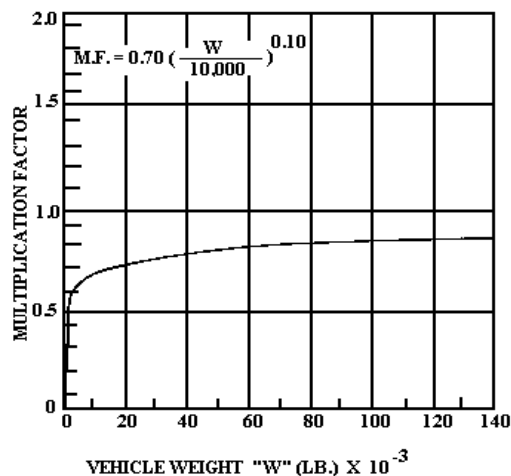


FIGURE W-13 - MINIMUM HORIZONTAL LOAD FACTOR FOR MOTOR GRADERS

- (h) Source of standard. This standard is derived from, and restates, the following Society of Automotive Engineers Recommended Practices: SAE J320a, Minimum Performance Criteria for Roll-Over Protective Structure for Rubber-Tired, Self-Propelled Scrapers; SAE J394, Minimum Performance Criteria for Roll-Over Protective Structure for Rubber-Tired Front End Loaders and Rubber-Tired Dozers; SAE J395, Minimum Performance Criteria for Roll-Over Protective Structure for Crawler Tractors and Crawler-Type Loaders; and SAE J396, Minimum Performance Criteria for Roll-Over Protective Structure for Motor Graders. These recommended practices shall be resorted to in the event that questions of interpretation arise. The recommended practices appear in the 1971 SAE Handbook, which may be examined in each of the Regional Offices of the Occupational Safety and Health Administration.

§1926.1002 Protective frame (roll-over protective structures, known as ROPS) for wheel-type agricultural and industrial tractors used in construction.

(a) General.

- (1) The purpose of this section is to set forth requirements for frames for the protection of operators of wheel type agricultural and industrial tractors to minimize the possibility of operator injury resulting from accidental upsets during normal operation. These frames shall

- meet the test and performance requirements of the Society of Automotive Engineers Standard J334a-1970, Protective Frame Test Procedures and Performance Requirements, which are incorporated by reference. The incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies may be obtained from the Society of Automotive Engineers, 485 Lexington Avenue, New York, NY 10017. Copies may be inspected at the OSHA Docket Office, U.S. Department of Labor, 200 Constitution Ave., NW., Room N2634, or at the Office of the **Federal Register**, 800 North Capitol St., NW., Suite 700, Washington, D.C. The standard also appears in the 1971 SAE Handbook, which may be examined in each of OSHA's Regional Offices. With respect to agricultural and industrial tractors, the provisions of §§1926.1001 and 1926.1003 for rubber-tired dozers and rubber-tired loaders may be utilized in lieu of the requirements of this section.
- (2) The protective frame that is the subject of this standard is a structure mounted to the tractor that extends above the operator's seat and conforms generally to Figure W-14.
 - (3) If an overhead weather shield is attached to the protective frame, it may be in place during tests: Provided, That it does not contribute to the strength of the protective frame. If such an overhead weather shield is attached, it must meet the requirements of paragraph (i) of this section.

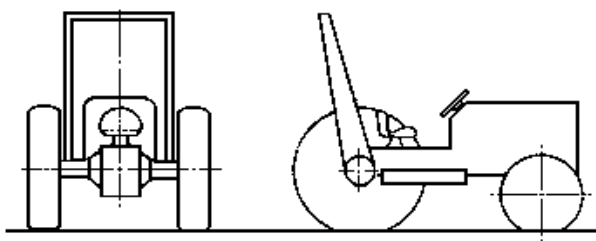


FIGURE W-14 -- Typical frame configuration.

- (4) For overhead protection requirements, see §1926.1003.
 - (5) If protective enclosures are used on wheel-type agricultural and industrial tractors, they shall meet the requirements of Society of Automotive Engineers Standard J168 (July 1970), Protective Enclosures, Test Procedures, and Performance Requirements. This standard appears in the 1971 SAE Handbook and may be examined in each Regional Office of the Occupational Safety and Health Administration.
- (b) **Applicability.** The requirements of this section apply to wheel-type agricultural tractors used in construction work and to wheel-type industrial tractors used in construction work. See paragraph (j) of this section for definitions of agricultural tractors and industrial tractors.
- (c) - (i) [Reserved]
- (j) **Definitions applicable to this section.**
- (1) SAE J333a, Operator Protection for Wheel-Type Agricultural and Industrial Tractors (July 1970) defines "agricultural tractor" as a "wheel-type vehicle of more than 20 engine horsepower designed to furnish the power to pull, carry, propel, or drive implements that are designed for agricultural usage." Since this Part 1926 applies only to construction work, the following definition of "agricultural tractor" is adopted for purposes of this subpart: "Agricultural tractor" means a wheel-type vehicle of more than 20 engine horsepower, used in construction work, which is designed to furnish the power to pull, propel, or drive implements.
 - (2) "Industrial tractor" means that class of wheeled type tractor of more than 20 engine horsepower (other than rubber-tired loaders and dozers described in §1926.1001), used in operations such as landscaping, construction services, loading, digging, grounds keeping, and highway maintenance.

§1926.1003 Overhead protection for operators of agricultural and industrial tractors.

- (a) **General**
- (1) **Purpose.** When overhead protection is provided on wheel-type agricultural and industrial tractors, the overhead provision shall be designed and installed according to the requirements contained in the test and performance requirements of Society of Automotive Engineers Standard J167-1970, Protective Frame with Overhead Protection-Test Procedures and

Performance Requirements, which pertains to overhead protection requirements and is incorporated by reference. The incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies may be obtained from the Society of Automotive Engineers, 485 Lexington Avenue, New York, NY 10017. Copies may be inspected at the OSHA Docket Office, U.S. Department of Labor, 200 Constitution Ave., NW., Room N2634, or at the Office of the Federal Register, 800 North Capitol St., NW., Suite 700, Washington, D.C. The standard also appears in the 1971 SAE Handbook, which may be examined in each of OSHA's Regional Offices. The provisions of §1926.1001 for rubber-tired dozers and rubber-tired loaders may be used in lieu of the standards contained in this section. The purpose of the standard is to minimize the possibility of operator injury resulting from overhead hazards such as flying and falling objects, and at the same time to minimize the possibility of operator injury from the cover itself in the event of accidental upset.

- (2) **Applicability.** This standard applies to wheel-type agricultural tractors used in construction work and to wheel-type industrial tractors used in construction work. See §1926.1002 (b) and (j). In the case of machines to which §1926.604 (relating to site clearing) also applies, the overhead protection may be either the type of protection provided in §1926.604 or the type of protection provided by this section.
- (b) Overhead protection.** When overhead protection is installed on wheel-type agricultural or industrial tractors used in construction work, it shall meet the requirements of this paragraph. The overhead protection may be constructed of a solid material. If grid or mesh is used, the largest permissible opening shall be such that the maximum circle that can be inscribed between the elements of the grid or mesh is 1.5 in. (38 mm.) in diameter. The overhead protection shall not be installed in such a way as to become a hazard in the case of upset.